EPC-31/32
Hardware Reference

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Hardware Warranty

RadiSys Corporation ("RadiSys") warrants the EPC system and component modules to the original purchaser for two years from the product's shipping date. If an EPC product fails to operate in compliance with its specification during this period, RadiSys will, at its option, repair or replace the product at no charge. The customer is, however, responsible for shipping the product; RadiSys assumes no responsibility for the product until it is received. This warranty does not cover repair of products that have been damaged by abuse, accident, disaster, misuse, or incorrect installation.

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1. Product Description

The EPC-31/32 are PC/AT compatible single board computers. The EPC-31 uses the 25 MHz Intel486 SX processor, and the EPC-32 uses the 33 MHz Intel486 DX processor. Where practical, this manual refers to the EPC-31/32 when discussing characteristics similar to both modules.

The EPC-31/32 has been designed to meet stringent safety and low EMI standards (UL-1950). All mounting bracket ports have filter networks for reduced EMI and increased ESD protection.

Many of the connectors on the EPC-31/32 provide power through different pins. Connecting the wrong cable or reversing the cable can damage the EPC-31/32 and may damage the device being connected. Use extreme caution when preparing to connect cables to this product. Refer to the diagram in Appendix A for complete connector labeling.

The EPC-31/32 processor module contains the following:

- A 25 MHz Intel486 SX or 33 MHz Intel486 DX processor
- Options for 0 and 1 MBytes of on-board base memory
- One 72-pin SIMM socket providing up to 16 MBytes of DRAM
- Full ISA bus compatibility, including DMA and interrupt controllers
- 2 RS-232 COM ports -- one 9-pin connector and one header connector
- LPT1 parallel port available through a header connector
- PC-compatible floppy drive controller accessed through a header connector
- IDE hard drive interface for 2.5" drives, using a 44-pin header
- PC/PS-2 keyboard interface via a 6-pin mini-DIN connector
- Time-of-day clock with user-replaceable battery
- Field-upgradable Award BIOS in flash memory
- Watchdog timer

Optional:

- Super VGA controller/flat panel display controller, with 512 Kbytes memory
- 1 or 2 MBytes on-board Flash memory configurable as a DOS bootable disk

Specifications

The following table lists the environmental and electrical specifications of the EPC-31/32.

Environmental		
Temperature	operating	0 - 60°C derated 2°C per 1000 ft (300 m) over 6600 ft (2000m)
	storage	-40 to 85°C
Humidity	operating	5 - 95% (non condensing)
	storage	5 - 95% (non condensing)
Altitude	operating	0 - 10,000 ft (3000 m)
	storage	0 - 40,000 ft (12,000 m)
Vibration	operating	2.5 g acceleration over 5-300 Hz sine wave (P-P), 1 oct/min sine sweep
	storage	5 g acceleration over 5-300 Hz sine wave (P-P), 1 oct/min sine sweep
Shock	operating	30 g, 11 ms duration, half-sine shock pulse
	storage	50 g, 11 ms duration, half-sine shock pulse
Electrical		
Current	typical	+5V @ 1.0A 486SX 25MHz +5V @ 1.1A 486DX 33MHz +12V @ 50mA for writing to flash BIOS or on-board flash memory

Table 1. EPC-31/32 Environmental and Electrical Specifications.

* Upper temperature limit degrades 2 C per 1,000 ft. elevation. Maximum elevation 10,000 ft.

Vibration and shock specifications assume the EPC-31/32 is mounted as a single board computer, and is not installed in a standard ISA chassis.
The EPC-31/32 is capable of driving a four-slot ISA backplane.
See Appendix A for mechanical dimensions.

22. Installation and Configuration

Before installing the EPC-31/32, unpack and inspect it for shipping damage.

* **do not remove the module from its anti-static bag unless you are in a static-free environment. the**

epc-31/32, like most other electrooic devices, is susceptible to esd damage. esd damage is not always immediately obvious, in that it can cause a partial breakdown in semiconductor devices that might not immediately result in a failure.

* **ensure that the installation process as described berein is also performed in a static-free environment.**

Installation

The EPC-31/32 can be installed in an ISA bus passive backplane or mounted using screw holes. If ISA bus connection is required when mounted using the screw holes, use the ISA bus header pins.

To mount the EPC-31/32 to a non-conductive surface using the four screw holes, be sure to select a location where you have access to all available header pins and connectors. Mounting holes on the EPC-31/32 are 1/8" (0.125") in diameter, or 3.175 mm. The spacing of the mounting holes is 6.1" (154.9 mm) by 3.55" (90.2 mm). Refer to Appendix A for a depiction of the EPC-31/32 mechanical dimensions.

It may be necessary to remove the PC mounting bracket from the EPC-31/32 before mounting flat on a surface.

Cooling requirements are minimal. In most cases a cooling fan is not necessary. Refer to the environmental specifications in Chapter 1 for temperature information.

Insertion of the EPC-31/32 into an ISA bus chassis or a passive backplane is straightforward. Remove a blank panel from the chassis and insert the EPC-31/32 into the backplane card connector. Firmly press the EPC-31/32 down to ensure that the module is properly seated in the backplane.

* **make sure system power is off. the epc-31/32 cannot be inserted into or removed from a live system.**
* **when inserting the epc-31/32, avoid touching the circuit board, and make sure the environment is static-free.**
* **insert it with adequate continuous force rather than tapping or hammering on it.**

Power-On Screen Display

During the setup and configuration of the EPC-31/32, a monitor and keyboard are required.

Whenever a hardware reset of the EPC occurs, the system performs a POST. If not set for "quick boot," the POST displays information showing the status of the BIOS self-test. If everything proceeds normally, the screen image displays approximately as shown below.

```
486 Modular BIOS V3.05abd.
Copyright (c) 1984-90 Award Software Inc.
Copyright 1993 RadiSys Corporation  Flash BIOS V3.05

TESTING INTERRUPT CONTROLLER #1 .........................OK
TESTING INTERRUPT CONTROLLER #2 .........................OK
TESTING CMOS BATTERY.....................................OK
TESTING CMOS CHECKSUM....................................OK
SIZING SYSTEM MEMORY.................................. 640K  FOUND
TESTING SYSTEM MEMORY................................. 640K  OK
CHECKING UNEXPECTED INTERRUPTS AND STUCK NMI ............OK
TESTING PROTECTED MODE...................................OK
SIZING EXPANSION MEMORY.............................. 3328K  FOUND
TESTING MEMORY IN PROTECTED MODE ..................... 4352K  FOUND
TESTING ONBOARD SERIAL PORT #1...........................OK
TESTING ONBOARD SERIAL PORT #2...........................OK
TESTING ONBOARD PARALLEL PORT............................OK

RadiSys EPC Setup Program
```

Figure 1. POST Display.

If errors occur during the power-on self-test, the BIOS displays the error on the appropriate line of the screen display and attempts to continue. For instance, if a failure is discovered in COM1, the BIOS disables COM1, displays the error on the line "TESTING ONBOARD SERIAL PORT #1 ....." and then continues as if the error did not occur. It is important to watch the POST display to verify that no errors occur.

If error messages are displayed during or after the POST display, see chapter 5, *Troubleshooting & Error Messages*.

BIOS Setup Screen

The EPC-31/32 BIOS contains a setup function to display and alter the system configuration. This configuration information is maintained in the EPC-31/32's battery-backed CMOS RAM and is used by the BIOS to initialize the EPC-31/32.

The setup function can be invoked any time after the POST completes and first clears the screen. Simultaneously press the CTRL+ALT+ESC keys. This may be done during system operation in most, but not all circumstances. Some programs that take control of the keyboard at a low level, such as Microsoft Windows, cause this key sequence to be interpreted differently, or not at all. It should always work, however, when the DOS operating system prompt is shown on the screen. The main setup screen displays similar to the following:

```
RadiSys EPC-31 CMOS Setup, Flash System BIOS V3.05
486SX, 4 MBytes memory, 487SX not present

Date (mm/dd/yy)                 01/12/90
Time (hh:mm:ss)                 09:34:56
Configuration Errors            Halt on all errors

Diskette Drive A                1.4M 3.5 inch
Diskette Drive B                None
Fixed Disk Drive C          AT
Fixed Disk Drive D          None

Cache                           Enabled
Quick Boot                      Disabled
Update BIOS                     Disabled

Com1:                           Enabled         F2 = Fixed Disk Menu
Com2:                           Enabled         F10= Save CMOS
LPT1:                           Enabled         ESC= Exit without saving
Floppy                          Enabled            move between items
IDE                             Enabled          select values
```

Figure 2. Main Setup Screen.

Use the up and down arrow keys to move the cursor from field to field. For most fields, once the cursor is positioned at the field, pressing the left and right cursor (arrow) keys will scroll through tbe available choices. Once the screen has been changed to appear as you desire, press the F10 function key to save the changes in battery-backed CMOS RAM. Then press the F5 function key to confirm the changes and reboot, F1 to confirm changes but not reboot or ESC to ignore any changes and exit. Each field is explained below.

Date and Time

These values are changed by moving to them and typing in the format shown.

Configuration Errors

This field provides several choices about the situations under which the BIOS should wait for user input if a configuration error is found. The selections are:

1) Halt on all errors
2) Ignore all errors
3) Ignore keyboard errors (allows operation without a keyboard)
4) Ignore disk errors
5) Ignore keyboard and disk errors

Diskette Drive

This field gives you several choices about the type of floppy disk drives installed as the A and B drives. Toggle the entry to match the type of diskette drive(s) attached. If no floppy drive is attached, select NONE for each diskette drive field.

Fixed Disk Drive

This display-only field shows the type of disk selected from the fixed disk menu. Possible values are None, AT and FLASH. To see the detailed characteristics of the device or to change the device, use the F2 function key to go to the fixed disk menu. See the section *Fixed Disk Menu*. This applies only to IDE disk drives attached directly to the EPC-31/32 and onboard flash, and does not apply to any external drives connected to other disk controllers.

Cache

Toggling this field enables or disables the cache. The default is to enable the cache.

Quick Boot

This field enables or disables the quick boot option. When quick boot is disabled, a hard boot causes the system to display the results of the POST and runs the memory test. When quick boot is enabled, the system runs the POST **except** the memory test and displays "Quick boot enabled: disable through Setup screen to view."

Update BIOS

Toggling this field enables or disables the BIOS serial update feature. When disabled, the system boots normally. When enabled, the system searches for 10 seconds on COM1 for clear-to-send (CTS) synchronization from an external host. The external host must be currently running the NEWBIOS.EXE program (refer to Flash BIOS updating in Chapter 3). If the system can synchronize with the host, the BIOS on the EPC-31 is reflashed and updated. Note that the field must be disabled on the next pass through the boot process. If the system cannot synchronize, after ten seconds the boot continues.

COM1/COM2

Toggling these fields enables or disables the built-in COM1 and COM2 ports.

LPT1

Toggling this field enables or disables the built-in LPT1 parallel port.

Floppy

Toggling this field enables or disables the built-in floppy controller. If using an external floppy controller, disable the EPC-31/32 floppy controller.

IDE

Toggling this field enables or disables the built-in IDE hard drive interface. If using an external IDE controller, disable the EPC-31/32 IDE controller.

Fixed Disk Menu

The Fixed Disk Menu is used to define the type of hard disk(s) installed in the system using the onboard IDE disk controller or Flash. Enter the fixed disk menu screen by pressing the F2 function key from the main setup screen. The Fixed Disk Menu screen is similar to the following:

```
RadiSys EPC-31 Fixed Disk Menu, Flash System BIOS V3.05
486SX, 4 MBytes memory, 487SX present

 Fixed Disk Drive C:  AT
     Type  17          41 MBytes:  977 Cyls,   5 Heads, 17 Sectors
                        Landing Zone:  977        Precompensation: 300

 Fixed Disk Drive D: None

                                                  F10 = Save and return
                                                  ESC = Return without saving
                                                     move between items
                                                   select values
```

Figure 3. Fixed Disk Menu Screen.

Use the up and down cursor keys ( ) to move between items. Use the left and right cursor keys ( ) to scroll through the available choices for each item.

Disk type **AT** denotes IDE-compatible drives. You can scroll through a set of numbered types; the physical configuration is displayed for each. Scroll through the numeric drive types to find the one matching the characteristics of the hard drive installed. Refer to the reference manual that accompanied the hard drive.

Choose disk type **Onboard Flash** if you are using the onboard flash memory. This flash memory can be made the boot device by making onboard Flash the drive C: type. However, if Drive C: is onboard Flash, Drive D: must be set to None. You cannot set the onboard Flash as the C: drive AND use an external disk controller (IDE or SCSI) to provide a D: drive.

User-Definable Drive Types

If the correct **AT** disk type is not listed, the EPC-31/32 provides user-editable drive types 48 and 49. Select either of these drive types. Use the TAB key ( )or the left and right cursor keys ( ) to move to the next (or previous) field. Note that the default settings for MBytes, Cylinders, Heads, and Sectors is 1. MBytes is a display-only field calculated by the BIOS. Move the cursor to each field (Cyls, Heads, and Sectors) and type the value for that field.

The BIOS allows use of the following maximum values:

Cylinders	1023	Heads	16	Sectors	63

The hard disk you are using may have parameters larger than the allowable maximum. If the number of cylinders for your drive is greater than the maximum allowable number, you may have to use 1023 cylinders which will limit the usable size of the drive. However, most IDE drives support universal translation mode. If the drive you are using supports this mode and the actual parameters are greater than tbe allowable maximum, divide the actual number of cylinders by 2 and multiply the actual number of heads by 2. That is, each sector is addressed as an absolute sequential sector number. Since the drive converts the sector data to an absolute number, these "false" cylinder and head numbers will still allow the full capacity of the drive to be used. The following example shows how this is done.

	Actual parameters	Conversion factor	Numbers to Use
Cylinders	1350	divide by 2	675
Heads	5	multiply by 2	10
Sectors	32	(none)	32
Total Sectors	216,000		216,000

Table 2. Fixed Disk Conversion Values.

After the fixed disk(s) have been configured, press F10 to save the data or ESC to ignore the changes. In either case you return to the main setup screen. Follow the instructions on the screen to save and exit or ignore changes and exit.

3. Theory of Operation

This chapter contains information about the following:

EPC-31/32 processor and coprocessor
EPC-31/32 memory map and memory expansion
ROM shadowing
Battery
Speaker
Miscellaneous connector
Resetting the EPC-31/32
Watchdog timer
Power and cooling requirements
Fuse
SVGA video controller
Flat panel support
Flash disk sub-system
Utilities software diskette
COM and Parallel ports
AT/ISA bus

Processor and Coprocessor

The EPC-31 uses the 25 MHz Intel486 SX CPU, which does not contain an integrated math coprocessor. The EPC-32 uses the Intel486 DX CPU, which runs at 33 MHz and contains an integrated math coprocessor. Note that this is not a socketed part, and therefore is not field-upgradable.

The board design uses the VLSI technology VL82C486 AT chip set to interface the 80486 to the AT-bus. The VL82C486 and its companion chip, the VL82C114, contain the following standard PC peripheral functions: two 82C37A DMA controllers, two 82C59A interrupt controllers, an 82C54 timer/counter, a 74LS612 memory mapper, 486 to AT bus data, address, and control strobe buffers, a real time clock with 128 bytes of battery backed SRAM, a PC compatible keyboard controller, a DRAM controller, and several miscellaneous functions.

Besides the standard AT peripheral registers, the VL82C486 contains 28 control registers that allow program control of DRAM access timing, memory mapping, and several other functions. These registers can only be accessed indirectly by writing an indirect register address to 0xEC, and following this write with an I/O access to 0xED to perform the actual read/write of the register desired.

Most of these functions are only set once by the BIOS at reset time. The BIOS or application software may disable access to these registers by performing an I/O write to 0xF9. Re-enabling access to the registers is accomplished by performing a dummy I/O write to 0xFB.

Memory

The EPC-31/32 can have an on-board base memory configuration of 0 or 1 Mbyte. When present, the base memory is soldered on the motherboard. This base memory can be expanded using a 4, 8 or 16 MByte SIMM module.

Additional RAM is supported via the ISA-bus (up to a maximum of 16 MBytes total).

After power on reset, the BIOS will find and size memory present in the system. The DRAM timing (in CPU clocks) in a 25MHz EPC-31 system is set to enable the 80486 bus to achieve 4-2-2-2 timing on burst reads that "hit" a previously activated page. The 33 MHz EPC-32 system is set to enable the 80486 bus to achieve 4-3-3-3 timing.

The DRAM controller is set to map 80486 addresses in the region from 0x000A0000 to 0x000EFFFF to the AT-bus (with the exception of 0x000C0000 - 0x000C7FFF, the video BIOS, which will be shadowed into main DRAM). Memory references to these addresses will not be cacheable by the 80486SX. Memory accesses beyond the installed DRAM are automatically sent to the AT bus. Accesses above 128MB wrap back around to address 0.

Memory Expansion

A single 72-pin SIMM socket is provided for memory expansion. SIMM memory occupies bank 2. A

standard SIMM module is used for memory expansion, or if no base memory is present, as primary RAM. Modules must meet the following criteria:

- fast page mode
- 72-pin
- 80 nanosecond DRAM or faster

Recommended part numbers for SIMMs are discussed in Chapter 6, *Upgrades*. The table below specifies the various SIMM modules used:

SIMM Memory	SIMM organization
4 MB	1 sided 1 MB x 36-bit
8 MB	2 sided 2 MB x 36-bit
16 MB	2 sided 4 MB x 36-bit

Table 3. SIMM Organization.

ROM and ROM Shadowing

The EPC 31/32 contains a flash BIOS device that is mapped into the last 128 Kbytes of the processor's address space. The flash device contains the PC BIOS, VGA BIOS, POST functions, and the setup screen program.

For best possible performance, the BIOS initialization software copies the system BIOS into DRAM (called shadowing) at addresses 0F0000-0FFFFF (also called the "F" page). After copying into this area, the BIOS write-protects it. Subsequent writes to this area complete successfully but do not alter the data. The system can only support one VGA controller. The BIOS also searches segment C800 through EFFFh for the existence of additional BIOS EPROMs. Additional BIOS extensions are not shadowed.

Battery

The battery powers the CMOS RAM and Time of Day clock when system power is not present. At 60°C, the battery should have a shelf life of over four years. In a system that is powered on much of the time and where the ambient power-off temperature is less than 60°C, the battery is estimated to have a life of 3 years.

The battery supplied with the EPC-31/32 is a 23mm. 3V lithium "coin" battery or equivalent (e.g. Panasonic BR200 or equivalent). Refer to Appendix A for mechanical dimensions and battery location. Should the battery fail, you may obtain and install a replacement. Figure 4 below illustrates how to change the battery.

Figure 4. Replacing the Battery.

Replacing the battery is a simple task. However, removing the battery will invalidate the CMOS setup parameters. It is recommended that all setup parameters be written down while the battery is still good.

Speaker

A very small speaker (0.5 in., or 12.7 mm) is installed on the EPC-31/32 and connected to the standard PC "beep" generation circuit. In high-noise conditions, a larger external speaker may be required. When used, an external speaker is driven by a 5V peak-to-peak square-wave signal, with current limiting resistors. Either a piezoelectric speaker or an electromagnetic speaker may be used externally.

The EPC-31/32 contains a miscellaneous function connector to provide access to the external speaker

circuit. The 14-pin 100-mil center header is explained further in Chapter 4, *Connectors*

Miscellaneous Connector

The Miscellaneous Connector CN4 contains a variety of signals used by standard PCs.

HDD access LED - a signal is provided for the user to connect an external LED to to indicate hard disk drive access. An external current-limiting resistor is not required; current will be limited by a 330 ohm resistor to VCC.

Power on LED - a signal is provided for the user to connect an external LED to indicate that power is applied to the system. An external current-limiting resistor is not required; current will be limited by a 330 ohm resistor to VCC.

Reset switch - an input is provided for the user to connect an external, SPST-NO switch to provide a reset input to the system. This signal may also be driven with an open-collector TTL signal.

Key switch input - an input is provided to port P17 of the keyboard controller. This is normally connected to a keylock switch to disable the keyboard in the PC/AT system. This input has an internal pullup resistor to VCC.

Battery input - an inpnt is provided to allow the connection of an external battery, to provide a voltage supply for the real-time clock and CMOS RAM. This connection is protected by a diode, and cannot source current from the on-board battery or VCC. The voltage supplied should in no case be greater than 5.5 volts.

Resetting the EPC

There are a number of ways to reset (reboot) the EPC.

Power-off, Power-on

This causes the entire system to reset. The system will run the power-on self-tests and reboot the operating system.

External Reset Input

The external reset input canses the EPC-31/32 to perform a hardware reset. The system will run the power-on self-tests and reboot the operating system.

Setup Screen

Pressing F10 and then F5 to save changes and reboot causes a processor shutdown. The system will run the POST and reboot the operating system. It does not cause an AT reset.

CTRL+ALT+DEL

This keyboard seqnence is called a "warm boot." The EPC does not reinitialize all of the processor's hardware. The power-on self-test does not run. However, the operating system will be reloaded. This type of reset typically only works under DOS.

Watchdog timer

This causes the entire system to reset. The system will run the power-on self-tests and reboot the operating system. See below for more details.

Additional abnormal conditions that cause a reset

Low Vcc

Watchdog timer

A watchdog timer function is included to provide a RESET signal to the CPU and ISA bus system in the event that software loses control of the system.

A register is present that enables or disables the watchdog timer function, and allows the selection of two different time-outs. The register returns the value FF when read. It is defined as follows:

Watchdog Register 0x384:

D7 - D2	D1	D0
Unused	Timeout length	Watchdog enable

If the timeont length bit is set to 0, the watchdog timeout will be set to 100 mS. If the bit is set to 1, a 1.6 second timeout will be selected. These times are approximate, +/- 20%, as they are determined by a passive RC circuit attached to a Maxim MAX696 reset generator IC.

If the watchdog enable bit (bit 0) is set to 0, the watchdog function is disabled. If the bit is set to 1, watchdog time-outs will be enabled, and the system will be reset at the end of the timeout period, unless the watchdog is reset by a read or write of the watchdog register.

Either a read or write operation to this register will reset the watchdog timer.
Upon system reset, this register will be initialized to 00.

Power and Cooling Requirements

In most applications, the EPC-31/32 will operate on 5V DC power only. The voltage required is between 4.75 and 5.25 volts. +12V must be supplied via the ISA-bus (or ISA-bus headers) to erase or program the FLASH devices, including the BIOS.
+5V may be supplied either via the ISA-bus edge connector, the ISA-bus header, or the power header (CN3). Care must be taken that the maximum current ratings of the connectors are not exceeded.

Cooling

The EPC-31/32 meets the standard RadiSys environmental specifications. This includes operation at temperatures from 0 to +60 C. The EPC-31/32 meets this specification in still air, with no forced cooling required.

Fuse

The EPC-31/32 has a user-replaceable fuse protecting the floppy disk circuit. The fuse is a Schurter 6.3V 2 Amp or equivalent (Schurter part number 3402.0012). Turn the system power off and either remove the EPC-31/32 from the system or remove the external power connector before attempting to replace the fuse. Some floppy drives can be powered through the data cable. This provides a convenience to the user so that an external power supply is not needed. These drives connect VCC through pins 7, 9, and 11 of the cable. Other drives connect GND to these pins. The EPC-31/32 supports both types of floppy drives. However, care must be taken when connecting the EPC-31/32 to the floppy so that VCC and GND are not shorted together. In particular, be careful with floppy drives that provide jumpers to configure whether VCC or GND is connected to these signals. If you are unsure which type of drive you have or don't know how the jumpers are configured for a specific drive, determine this from the drive specifications before connecting the drive to the EPC-31/32.

⚠ CAUTION

This fuse is not installed when the unit is shipped. If you are using a floppy disk drive that is powered through the ribbon cable, be sure to install the fuse. If your floppy disk drive is powered through a power cable, do not install the fuse.

SVGA Video Controller

An SVGA video and flat-panel display controller is optional on the EPC-31/32. The controller is implemented with a Chips and Technologies (C&T) 65535 controller. The 65535 controller supports virtually all flat panel displays, including single and dual scan monochrome LCD's, EL and plasma displays, and STN and TFT color LCD displays, as well as analog VGA monitors.
The SVGA controller resides on the 32-bit 486 local bus. The 512 KBytes of video memory is implemented with a single 256kx18 DRAM device. This memory provides standard VGA modes on a CRT or flat panel display, with up to 640x480 resolution in 256 colors. It also provides super VGA modes up to 1024x768 on flat panel displays, and CRT displays of 800x600 256 colors, and 1024x768 16 colors. A standard 15-pin high-density D-sub connector, accessible on the AT-card bracket is provided to connect to a standard VGA monitor. A 50-pin .079" [2.00 mm] pitch ribbon-cable header is also present on the board to provide connection to a flat panel display.
The ROM BIOS code for the SVGA controller is included in the same BIOS flash EPROM that the main system BIOS resides in. The default setting supports a standard VGA CRT monitor. It is possible to change the video BIOS support flat-panel displays after the board has left the factory. Refer to *Flash BIOS Updating* later in this chapter for more information.

Flat Panel Support

The EPC-31/32 supports a wide variety of flat panels using the onboard flash to contain the video BIOS. This onboard flash is updated using the floppy disk supplied with the EPC-31/32.
There is no DC-DC converter onboard for use in adjusting the flat panel voltage. If your flat panel requires adjustment, you will need a DC-DC converter with a trimpot.
Many flat panels require 600 VAC for backlight. If your flat panel falls in this category, you will need to provide an inverter. Inverters are available from the flat panel supplier.

Due to the wide variety of flat panels on the market, you must provide your own "custom" cable. At this printing, flat panel manufacturers have not standardized on any one cable or connector. Refer to Appendix D, *Video Modes and Supported Panels* for more information.

Flash Disk Subsystem

Two 8-megabit flash memory devices may be factory installed on the EPC-31/32.

This flash memory is not located in the processor's memory address space; it is accessed indirectly through I/O reads and writes. Single byte I/O writes to 0x380-0x382 are saved in latches that setup the lower, middle, and high address bits that drive the flash memory's address lines. I/O reads/writes to 0x383 access the flash data at the address stored in the latches. These latches contain indeterminate data at power-up, and are not cleared by a system reset.

This architecture is compatible with the flash system architecture used on other RadiSys products.

Reading the flash file system is performed using the standard DOS disk INT calls. The flash disk appears as the "C:" or "D:" drive, depending on the setup screen entry.

NOTE: +12V must be supplied via the ISA-bus (or the ISA-bus headers) to allow erasing and writing the flash disk device.

EPC-31/32 Utilities Diskette Contents

The utilities diskette contains the following flash format files:

XFORMAT.EXE	**Flash formatting program**
BB5.00	**Boot block files for DOS 5.0**
BB6.00	**Boot block files for DOS 6.0, 6.1, & 6.2**
README.TXT	**Additional user information added after the manual was printed**

Additional flat panel support files are listed later in this chapter.

Onboard Flash Utility Installation

Create a directory on the C: drive called C:\FLASH (or another name you choose). Copy the flash files from the distribution diskette to the C:\FLASH directory.

Formatting Program

In order to format the EPC-31/32 onboard flash, use the program named XFORMAT. It is distributed on the floppy diskette shipped with the EPC-31/32. Note that this software is also used with the RadiSys EXM-2A flash memory module, where both flash and SRAM memory are formattable. Ignore all references to formatting SRAM memory.

When xformat is used to format flash memory, the function first erases all flash memory, formats it, optionally adds system files to make it a boot device, and then copies a directory structure and files into it. The program is invoked with the following command line:

XFORMAT [*options*] [*srcdir*]

All files in directory *srcdir* (typically a directory on your hard disk) and all of its subdirectories (if any) and their files are copied into the EPC-31/32. To make changes to the flash disk you must rerun the XFORMAT function.

Each file is created with the same attributes and date/time stamp as the source file, except the files are also marked as read-only and unarchived (see the DOS ATTRIB command for more information).

The following flags are available when using the XFORMAT function. Note that a dash (-) can be used interchangeably with a slash (/) to set flags.

/B=<sysdir> **Boot Disk Flag.** Creates a bootable disk image using the DOS system files specified by the **<sysdir>** parameter. The function formats and copies files to the formatted disk. A bootable disk image is created. The operation fails if it cannot find the operating system files.

It is possible to create a bootable disk image from a non-bootable source drive. Contact RadiSys Technical Support for details.

/F<name> <size>

File Output Flag. Outputs the disk image to the file **<name>** with size **<size>.** **<size>** is a hex value that specifies the number of Kbytes in the target file. This option is useful for creating VME memory disks and images for users that are going to write their own flash

writing program, and is documented here for completeness.

/H **Help Flag**. Displays a list of available flags and their options. Ignore all references to SRAM memory and the EXM-2A.

/N=<ver> **Non-Boot Version Flag**. Creates a bootable disk image using the boot block file specified by the **<ver>** parameter. (The location of the boot block file is specified by **/B** or **/S** flags.) This option is useful for creating bootable flash disks from non-bootable sources such as network and RAM disk drives (see Appendix D for more information on creating bootable images from non-bootable disks). The boot block file for **/N=5** is **BB5.00** (DOS 5) and the boot block file for **/N=6** is **BB6.00** (DOS 6.X). The boot block files are supplied with the EPC-31/32 flash diskette. This operation fails if it cannot find the operating system files.

/P=<slot> **Position Flag**. **Not applicable to this product.** (This flag is only for use when **XFORMAT** is operated with an EXM-2A, and refers to the EXM slot number.)

/Q=m **Quiet Mode Flag**. Suppresses progress display messages. May be combined with the No Reboot Flag (i.e., **/Q=mr**).

/Q=r **No Reboot Flag**. Suppresses reboot upon successful completion. May be combined with tbe Quiet Mode Flag (i.e., **/Q=rm**).
It is necessary to flush the DOS buffer areas prior to accessing newly formatted disks. This is accomplished by rebooting. This reboot suppression flag is strictly for use when **XFORMAT** is used in a batch file where the reboot command is at the end of the batch file.

/S **System Flag**. Creates a bootable disk image using the DOS system files on the disk that **XFORMAT** is invoked from.
This operation fails if it cannot find the operating system files.

/T=<type> **Type Flag**. Specifies the type of format to be performed. When **<type>** is S, the function formats the SRAM. When **<type>** is **O**, the function formats the onboard flash (flash memory on the CPU board). When **/T=O** is selected, the **/P** flag is not allowed.

NOTE: You must specify option **O** when formatting the EPC-31/32 onboard flash.

/V **Volume Label Flag**. Prompts for a disk volume label. A volume label identifies the disk and can be a maximum of 11 characters. The label conforms to the MS-DOS convention, thus the following are not allowed: * . + , : ; < > = ? [ ] \ / | ( ) ^ & . Label letters are converted to upper case.

Note that not all flags are valid for every system. For example, **/T=O** is used only for **systems that contain onboard flash memory (i.e., flash memory on the EPC-31/32 CPU).**

Some examples of the **XFORMAT** invocation are described below.

```
XFORMAT /B=A:\ A:\
```

Formats the EXM-31/32 flash memory as a DOS system disk from the DOS system disk in drive A:, and copies all files from device A: into the EPC-31/32 flash (including subdirectories).

```
XFORMAT A:\
```

Formats the EXM-31/32 flash memory and copies all files from device A: into the EPC-31/32 flash (including subdirectories). The EPC-31/32 flash will not be bootable if not formatted with the **/S** or **/B** flag.

```
XFORMAT /N=6 /b=D: C:\FLASH
```

Format the flash memory using the system files and the boot block file **BB6.00** from directory **D:** and copy all files from **C:\FLASH**. Note that you cannot simply copy a file to a flash disk. You must use **XFORMAT** to erase, format, and copy the contents of a directory to the flash disk.

Unless the **/F** option is selected, **XformAT** automatically determines the amount of available space on your EPC-31/32 flash. It also calculates the amount of space needed for the files to be copied, and aborts without erasing the EPC-31/32 flash if there is insufficient space.

XFORMAT aborts if the source device (for either the file copy or for the system files) is the same EPC-31/32 flash being formatted.

Since the EPC-31/32 flash is represented to DOS as a fixed (non-removable) disk, DOS may have buffered data from the EPC-31/32 flash's files prior to its being formatted. As a result, you should reboot your system prior to accessing files in a newly formatted EPC-31/32 flasb.

XFORMAT Error Messages

The following messages may display during error conditions using **XFORMAT.EXE** .

Error Message BATTERY NEEDS REPLACEMENT
Explanation The **XFORMAT** program detected that the battery power is below 2.5V.
Resolution Replace the battery. Refer to Figure 4 for procedure and Appendix A for location.

Error Message CANNOT READ COMMAND.COM
Explanation **COMMAND.COM** could not be located.
Resolution Copy **COMMAND.COM** to the appropriate directory and re-invoke **XFORMAT**.

Error Message <path> COMMAND.COM WILL NOT BE COPIED TO THE TARGET
Explanation A version of **COMMAND.COM** was found in the top directory of the **<srcdir>**.
Resolution Delete **COMMAND.COM** from the **<srcdir>** directory and re-invoke **XFORMAT**.

Error Message INSUFFICIENT SPACE ON TARGET DEVICE
Explanation The source directory is too large to fit onto the target.
Resolution Remove some of the files from the source directory.

Error Message INVALID SOURCE PATHNAME
Explanation **XFORMAT** could not find the directory specified as the source pathname.
Resolution Ensure that the source pathname exists.

Error Message INVALID TARGET SIZE SPECIFIED
Explanation An illegal character was detected in the file size portion of the **/F** parameter.
Resolution Specify the file size using only hex characters.

Error Message MORE THAN ONE SOURCE PATH WAS SPECIFIED
Explanation Multiple source paths were detected on the command line.
Resolution Remove one of the source paths from **XFORMAT**'s invocation line.

Error Message NO ARGUMENTS SPECIFIED
Explanation The command line does not specify any operations.
Resolution Execute **XFORMAT** with **/H** to display flags and options.

Error Message SOURCE PATHNAME TOO LONG
Explanation Insufficient storage for the pathname string.
Resolution Copy the files to a directory that is closer to the root.

Error Message SYSTEM DOES NOT CONTAIN ONBOARD FLASH
Explanation **/T=O** was specified for a system that does not contain onboard flash (flash on the CPU card).
Resolution Check that onboard flash is present and try again.

Error Message TARGET SIZE NOT SPECIFIED
Explanation The **/F** option is ill-formed.
Resolution The syntax for the **/F** flag is **/F<filename> <size>**. The filename is specified and is followed by the file size in kilobytes.

Error Message UNABLE TO INITIALIZE FLASH DEVICE
Explanation **XFORMAT** cannot write to flash memory if no power is present. Or, no flash memory exists.
Resolution Check that the system is properly connected to a +12V power supply.

Error Message UNABLE TO READ BOOT RECORD FILE
Explanation The boot record files are not in the **<srcdir>** path.
Resolution Copy the boot record files to the proper directory

For this example, assume that you are updating the BIOS on the system that is running NEWBIOS.EXE. Therefore, to update the BIOS in self-hosted mode, follow the instructions below:

1. Insert the EPC-31/32 BIOS update diskette in drive A.
2. Switch the command line to drive A by typing A: and pressing <ENTER>.
3. Display the contents of the NEW.BAT file by typing TYPE NEW.BAT and press <ENTER>.

The first time you perform this step, the following default file contents display:

NEWBIOS /F=FILL16.BIN /F=VCRT31.BIN /F=EPC31.BIN /F=FILL8.BIN

4. You MUST edit the NEW.BAT batch file to select the appropriate system and VGA BIOS from the list of files below. Note that VCRT31.BIN does not exist on the Utilities diskette; you MUST replace this file name with the appropriate VGA BIOS that matches your panel type. For standard desktop VGA monitors, use VCRT.BIN. Otherwise, if using a flat panel, choose the appropriate flat panel file. *Even if you are only updating the system BIOS, you must still place a VGA binary in the file* Make sure the new VGA BIOS you are using is the *exact size* of VCRT31.BIN (32,768 bytes).
5. Run the NEW.BAT file to begin the update.
6. The following message displays: "You have selected to update this computer's BIOS. Is this correct? (Y/N) : "
   Select Y for yes if you are ready to proceed. Proceed to the next step. Select N for no if you want to re-check the NEW.BAT contents; go back to step 3.
7. Each file name included in NEW.BAT displays as the program executes.
8. This message displays: "Update completed successfully. Press any key to reboot."

Press any letter or number on the keyboard. The system reboots using the new BIOS. Use this same procedure to update the BIOS using the remote download procedure, making sure to include the port designation (/P=) as discussed above.

These files are included for system updating with the EPC-31/32 utilities diskette:

NEW.BAT	Self-hosted update batch file
VCRT.BIN	32 KBytes Standard CRT VGA BIOS
VLJ64OU3.BIN	32 KBytes VGA BIOS for Sharp 64OU3 flat panel
VLM64CO8.BIN	32 KBytes VGA BIOS for Sharp 64CO8 flat panel
VLM64P80.BIN	32 KBytes VGA BIOS for Sharp 64P80 flat panel
VLQ10DH1.BIN	32 KBytes VGA BIOS for Sharp LQ10DH11 flat panel
NEWBIOS.EXE	Flash BIOS update program invoked from NEW.BAT
FILL8.BIN	8 KBytes fill file for unused portion of flash device
FILL16.BIN	16 KBytes fill file for unused portion of flash device
EPC31.BIN	64 KBytes EPC-31/32 System BIOS

Refer to the README.TXT file on the floppy for additional information. Note that you cannot use the NEWBIOS.EXE file on this Utilities diskette with any other RadiSys EPC, and you can only use NEWBIOS.EXE shipped on the EPC-31/32 Utilities diskette on the EPC-31/32.

Peripheral Interfaces

Serial and parallel port functions, a floppy disk drive controller, and decode logic for an IDE interface are contained in a multi-IO chip, the FDC37C651, manufactured by Standard Microsystems Corp. (SMC). For details of the operation of these functions, refer to the SMC data sheet for this device.

The COM1 serial port is located in the I/O address range 0x3F8-0x3FF. COM1 serial port interrupts are signaled using IRQ4. Connection to COM1 is provided by a standard male DB-9 connector mounted on the card bracket. The COM2 serial port is located in the I/O address range 0x2F8-0x2FF. COM2 serial port interrupts are signaled using IRQ3. Connection to COM2 is made via a standard header connector on the board that is shared with the parallel port.

Both COM ports are 16C550-compatible and contain 16-byte FIFOs. The best way to bring up the FIFO is to set it up within the applications software, but if that is not possible it can be set through the debug (or equivalent) routine. Writing to 0x3FA with the hex value 01 enables the COM1 FIFO; writing to 0x2FA with the hex value 01 enables the COM2 FIFO.

Error Message	UNRECOGNIZED FLAG
Explanation	A mis-spelled or illegal flag was used.
Resolution	Check the command line to ensure only legal flags are used.

Any function or application other than **XFORMAT** that attempts to write *to* the flash disk will cause the system to lock up. Typical applications that write to disk might be Norton Utilities or PC Tools; typical DOS functions would be **COPY, XCOPY, FORMAT**, and **FDISK**.

The flash portion of the EPC-31/32 is visible to the operating system as a separate logical drive. Applications that read the flash memory operate identically as if they were reading any "read only" media, such as CD-ROM disks.

Flash BIOS Updating

The EPC-31/32 supports flash BIOS updates for both system and VGA BIOS. These updates are accomplished by running the NEW.BAT file, found on the EPC-31/32 utilities diskette. NEW.BAT calls the DOS executable NEWBIOS.EXE

The Utilities diskette contains two subdirectories, \FLASH and another subdirectory named using a 5-digit number to indicate the BIOS level included on the diskette. At this writing, this subdirectory is \30600 (BIOS version 3.06.00).

The NEWBIOS program executes in either self-hosted or remote download modes. Self-hosted mode is for updating the flash BIOS of the system in which the NEWBIOS program is executing and is the default mode.

Remote download operations are only necessary for reprogramming a BIOS damaged by power failure during a previous update process, or if a floppy drive is not present in the EPC-31 system. Remote download requires a remote PC connected by a NULL modem cable to the EPC-31/32's COM1 port, and the command line must contain the /P parameter to indicate which port is to be used on the computer running the NEWBIOS program (not the COM port on the EPC-31/32). For example, use /P = 1 for COM1 on the source computer. Note also that when performing a remote download, you must set the Update BIOS prompt in the BIOS setup to [ENABLE]. Refer to page 8, *Update BIOS*.

NEWBIOS can run from the floppy drive or the hard disk. To install the update files on your hard disk, create a subdirectory on your hard disk drive and use the DOS COPY command to copy the files from the \30600 directory. To display the usage model, type NEWBIOS and press <ENTER>. Available options include:

NEWBIOS /F=<filelist> [/C=timeout] [/R=retries] [/P=port]

/C = <ms>	**Wait period. Default is 30000 milliseconds.**
/R = <count>	**Retries. Default is 16 retries.**
/P = <n>	**COM port used on the source computer for remote downloads.**

If no port selection is made using the /P=Port # parameter, NEWBIOS begins execution in self-hosted mode. NEWBIOS reprograms 120 Kbytes of the 128K flash BIOS. The first 8 Kbytes are used for the boot block and are not reprogrammable.

Download files are specified by using the /F=<filename> parameter. Files are copied into flash memory from low to high memory addresses. The files list must provide for the necessary files, in the correct order, and located at the correct offsets. To help accomplish this, two files (FILL16.BIN and FILL8.BIN) are included on the Utilities diskette.

The necessary order and offsets are as follows:

Offset	File	File(s) to Use
0	16K "filler"	FILL16.BIN
16K	32K video BIOS	video BIOS + filler as needed to achieve 32K
48K	64K system BIOS	EPC31.BIN
112K	8K "filler"	FILL8.BIN

Note that the video BIOS must consume a total of 32 Kbytes. If the video BIOS file is less than 32 KB, you must fill it to a total of 32K. For example, if the video BIOS is only 31K, you must "pad" the file with NULLs until the file size is exactly 32 KB (32,768 bytes). If the video BIOS is only 24KB, you may use an additional FILL8.BIN entry to consume the remainder of the 32 KB required before the system BIOS is installed. It could be necessary to combine both these techniques depending on the particular video BIOS chosen.

The parallel port is located in the I/O address range 0x378-0x37A. Parallel port interrupts are signaled using IRQ7. Connection to this port is made via a header connector on the board that is shared with the COM2 serial port. The parallel port is bi-directional.
The floppy disk controller is fully PC-compatible, supporting one or two floppy drives. It occupies I/O addresses 0x3F2, 0x3F4, 0x3F5, and 0x3F7. It uses bus interrupt IRQ6 and the 8-bit DMA channel corresponding to DRQ2 and ~DACK2 on the AT bus. Connection to a floppy disk drive is made via a standard 34-pin ribbon cable header mounted on the PCB. Power for the drive may be provided through a socketed SMT fuse via the cable. If the power via the cable is not desired, the fuse is removed from the socket. If power is provided through the ribbon cable, only one floppy drive can be connected and must use a straight ribbon cable, not a twisted ribbon cable. Using a twisted ribbon cable will blow the fuse.
The IDE interface is mapped to I/O addresses 0x1F0 - 0x1F7, 0x3F6, and 0x3F7. Note that I/O address 0x3F7 is shared with the floppy disk controller as required for PC compatibility. The IDE hard disk uses interrupt IRQ14. Connection to an IDE hard disk is made through a 44-pin 0.079" [2.0 mm] pitch ribbon cable header (the standard for 2.5" and 1.8" HDD's) mounted on the PCB.

ISA bus

The ISA bus signals are provided by the VLSI VL82C486 and VL82C114 IC devices. No additional buffering is required or provided. The VL82C486 supports programmable AT-bus buffer drive capability. This design sets the buffer strengths, Iol and Ioh, to 12mA.
The clock speed of the ISA bus will be set to 8.0 MHz.
Terminations contained on the EPC-31/32 CPU board are as follows:

Signals Termination
Address lines SA0 - SA19, and LA17 - LA24: 10k pullup to VCC
Data lines SD0 - SD15: 10k pullup to VCC
Control strobes ~IOR, ~IOW, ~MEMR, ~MEMW: 4.7k pullup to VCC
Control strobes ~SMEMR and ~SMEMW are totem-pole outputs and require no termination
Xfer response signals ~IOCS16, ~MEMCS16, ~0WS, ~MASTER: 300 ohm pullup to VCC
DRQ inputs: Approximately 10k pullup to VCC, internal to VL82C486
IRQ inputs: Approximately 10k pullup to VCC, internal to VL82C486
~REFRESH output: Open-collector, with 300 ohm pullup to VCC
RESETDRV, OSC, BALE, AEN, SYSCLK, and TC are totem-pole outputs and require no termination
~SBHE output: 10k pullup to VCC
~IOCHCK input: 4.7k pullup to VCC
IOCHRDY input: 1k pullup to VCC

Table 4. EPC-31/32 Terminations.

Note that pullups are provided on lines driven by the "current master" in order to place these lines in a known state during the transfer of control to an ISA-bus add-in card that uses the MASTER feature to gain control of the bus from the CPU.

NOTES

4. Connectors

Overview

This chapter specifies the pin-outs of the connectors on the EPC-31/32. These connectors adhere to existing standards. Pins are labeled from the point of view of looking into the front of the connector on the EPC-31/32. Refer to Appendix A for the board location of each connector.
The following table lists each connector (or equivalent) and the part number for the suggested mate:

Ref.	Function	On PCB	Suggested Mate
J1	VGA	JST KSEY-15S-1A3F19-13	AMP 748364-1
J2	COM1:	JST JSEY-9P-1A3F19-13	AMP 205204-4
J3	KBD:	JST MD-S6100-90	AMP 750206-4
CN1	HDD	Samtec STMM-122-01-$-D-20	3M 152244-0110-GG
CN2	FDD	3M 2534-6002UB	3M 3414 6600
CN3	COM2/LPT	3M 2534-6002UB	3M 3414 6600
CN4	Misc.	3M 2514-6002UB	3M 3385-6600
CN5	Flat Panel	Samtec STMM-125-01-$-D	3M 152250-0110-GG
CN6	Power	AMP 171826-4	AMP 1718224
CN7	AT CD Header	Samtec TSW-132-07-S-D	Samtec SSW-132-01-G-D
CN8	AT CD Card Edge	N/A	AMP 645169-2
CN9	AT AB Header	Samtec TSW-120-07-S-D	Samtec SSW-120-01-G-D
CN10	AT AB Card Edge	N/A	AMP 645169-2

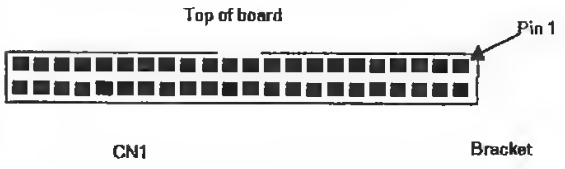
Note that CN8 and CN10 are on the same card edge. Where applicable, each connector drawing has a label for the "top" of the EPC-31/32, or opposite of the gold-plated bus connectors, and the "bracket" side, meaning the edge of the board with the COM and SVGA connector.

IDE Hard Disk Drive Controller

IDE HDD pin-out (CN1): 22x2, 0.079" [2.0 mm] pitch header

1	~RESET	2	GND
3	D7	4	D8
5	D6	6	D9
7	D5	8	D10
9	D4	10	D11
11	D3	12	D12
13	D2	14	D13
15	D1	16	D14
17	D0	18	D15
19	GND	20	key
21	n/c	22	GND
23	~IOW	24	GND
25	~IOR	26	GND
27	IOCHRDY	28	n/c
29	n/c	30	GND
31	IRQ	32	~IOCS16
33	A1	34	~PDIAG
35	A0	36	A2
37	~HCS0	38	~HCS1
39	~DASP	40	GND
41	VCC	42	VCC
43	GND	44	n/c

Table 5. IDE Hard Disk Drive Connector Pin-out.



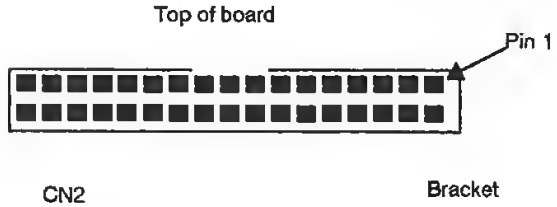
Floppy Disk Drive Controller

FDD pin-out (CN2): 17x2, 0.100" [2.54 mm] pitch header

1	GND	2	~DENS		
3	n/c	4	n/c		
5	n/c	6	n/c		
7	Fused VCC *		8	~INDEX	
9	Fused VCC *		10	~MO1	
11	Fused VCC *		12	~DS0	
13	GND	14	~DS1		
15	GND	16	~MO0		
17	GND	18	~DIR		
19	GND	20	~STEP		
21	GND	22	~WDATA		
23	GND	24	~WGATE		
25	GND	26	~TRK00		
27	GND	28	~WRPRT		
29	GND	30	~RDATA		
31	GND	32	~SIDE		
33	GND	34	~DSKCH		

Table 6. Floppy Disk Drive Pin-out.

*** Note: Pins 7, 9, and 11 are not connected unless the fuse is installed.**

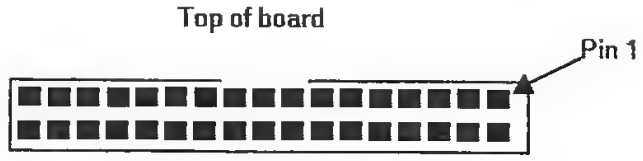


COM2/LPT1 Connector

The COM2 serial port is included with LPT1 on the CN3 header.

Pin	Signal	Pin	Signal	
1	COM2: DCD	2	COM2: DSR	
3	COM2: RXD	4	COM2: RTS	
5	COM2: TXD	6	COM2: CTS	
7	COM2: DTR	8	COM2: RI	
9	GND	10	LPT1: ~STB	
11	LPT1: ~AUFD	12	LPT1: D0	
13	LPT1: ~ERROR	14	LPT1: D1	
15	LPT1: ~INIT	16	LPT1: D2	
17	LPT1: ~SLIN	18	LPT1: D3	
19	GND	20	LPT1: D4	
21	GND	22	LPT1: D5	
23	GND	24	LPT1: D6	
25	GND	26	LPT1: D7	
27	GND	28	LPT1: ~ACK	
29	GND	30	LPT1: BUSY	
31	GND	32	LPT1: PE	
33	GND	34	LPT1: SLCT	

Table 7. COM2/LPT1 Pin-out.

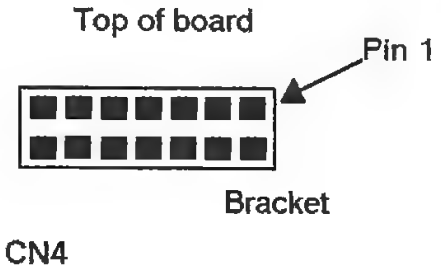


Miscellaneous Connector

Miscellaneous connector (CN4) 7x2, 0.100" [2.54 mm] pitch header

1	KEYLOCK SW IN	2	GND
3	HDD LED ANODE	4	HDD LED CAT
5	PWR LED ANODE	6	PWR LED CAT
7	RST SW IN	8	GND
9	SPRK OUT	10	GND
11	BATT + IN	12	GND
13	n/c	14	n/c

Table 8. Miscellaneous Connector Pin-out.



Flat Panel Display Connector

Flat panel disp. pin-out (CN5): 25x2, 0.079" [2.00 mm] pitch header

1	VCC	2	GND	
3	n/c	4	P8	
5	n/c	6	P9	
7	ENAVDD	8	GND	
9	ENAVEE	10	P10	
11	GND	12	P11	
13	M	14	GND	
15	FLM	16	P12	
17	GND	18	P13	
19	LP	20	GND	
21	~SHFTCLK	22	P14	
23	GND	24	P15	
25	SHFTCLK	26	GND	
27	GND	28	P16	
29	P0	30	P17	
31	P1	32	GND	
33	GND	34	rsvd	
35	P2	36	rsvd	
37	P3	38	GND	
39	GND	40	rsvd	
41	P4	42	rsvd	
43	P5	44	GND	

45	GND	46	rsvd
47	P6	48	rsvd
49	P7	50	GND

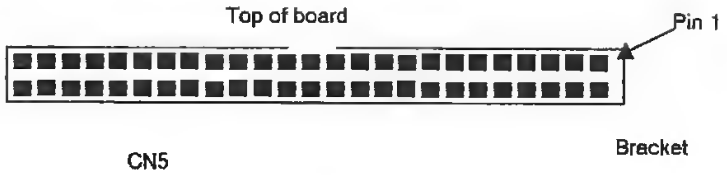


Table 9. Flat Panel Display Connector Pin-out.

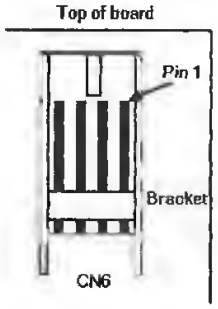
Power Connector

The EPC-31/32 power connector inside pins are ground and outside pins are VCC.

POWER(CN6) : AMP #171825-4, 4 position, 0.098" [2.50 mm] pitch

1	VCC
2	GND
3	GND
4	VCC

Table 10. Power Connector Pin-out.



AT/ISA Bus Connector Pin-out

AT-bus pin-out (AT side) (CN7, CN8): 20x2, 0.100" [2.54 mm] pitch header 18x2, 0.100" [2.54 mm] pitch card edge

CN7 (hdr)	CN8 (edge)		Signal	CN7 (hdr)	CN8 (edge)	Signal
1	C1	~SBHE	2	D1	~MEMCS16	
3	C2	LA23	4	D2	~IOCS16	
5	C3	LA22	6	D3	IRQ10	
7	C4	LA21	8	D4	IRQ11	
9	C5	LA20	10	D5	IRQ12	
11	C6	LA19	12	D6	IRQ15	
13	C7	LA18	14	D7	IRQ14	
15	C8	LA17	16	D8	~DACK0	
17	C9	~MEMR	18	D9	DRQ0	
19	C10	~MEMW	20	D10	~DACK5	
21	C11	SD8	22	D11	DRQ5	
23	C12	SD9	24	D12	~DACK6	
25	C13	SD10	26	D13	DRQ6	
27	C14	SD11	28	D14	~DACK7	
29	C15	SD12	30	D15	DRQ7	
31	C16	SD13	32	D16	VCC	
33	C17	SD14	34	D17	~MASTER	
35	C18	SD15	36	D18	GND	
37	n/p	GND	38	n/p	GND	
39	n/p	GND	40	n/p	GND	

Table 11. AT-bus Pin-out, AT side.

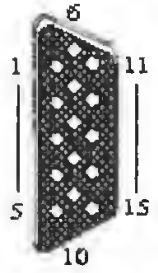
Refer to Appendix C for a description of the AT bus connector signals.

AT-bus pin-out (XT side) (CN9, CN10): 32x2, 0.100" [2.54 mm] pitch header 31x2, 0.100" [2.54 mm] pitch card edge

CN9 (hdr)	CN10 (edge)	Signal		CN9 (hdr)	CN10 (edge)	Signal
1	A1	~IOCHCK	2	B1	GND	
3	A2	SD7	4	B2	RESETDRV	
5	A3	SD6	6	B3	VCC	
7	A4	SD5	8	B4	IRQ9	
9	A5	SD4	10	B5	n/c	
11	A6	SD3	12	B6	DRQ2	
13	A7	SD2	14	B7	n/c	
15	A8	SD1	16	B8	~0WS	
17	A9	SD0	18	B9	+12V	
19	A10	IOCHRDY		20	B10	GND
21	A11	AEN	22	B11	~SMEMW	
23	A12	SA19	24	B12	~SMEMR	
25	A13	SA18	26	B13	~IOW	
27	A14	SA17	28	B14	~IOR	
29	A15	SA16	30	B15	~DACK3	
31	A16	SA15	32	B16	DRQ3	
33	A17	SA14	34	B17	~DACK1	
35	A18	SA13	36	B18	DRQ1	
37	A19	SA12	38	B19	~REFRESH	
39	A20	SA11	40	B20	SYSCLK	
41	A21	SA10	42	B21	IRQ7	
43	A22	SA9	44	B22	IRQ6	
45	A23	SA8	46	B23	IRQ5	
47	A24	SA7	48	B24	IRQ4	
49	A25	SA6	50	B25	IRQ3	
51	A26	SA5	52	B26	~DACK2	
53	A27	SA4	54	B27	TC	
55	A28	SA3	56	B28	BALE	
57	A29	SA2	58	B29	VCC	
59	A30	SA1	60	B30	OSC	
61	A31	SA0	62	B31	GND	
63	n/p	GND	64	n/p	GND	

Table 12. AT-bus Pin-out.

SVGA Connector



SVGA pin-out (J1): 15-pin female high-density D-sub

1	RED
2	GREEN
3	BLUE
4	n/c
5	GND
6	ANALOG GND
7	ANALOG GND
8	ANALOG GND
9	n/c
10	GND
11	n/c
12	n/c

13	H SYNC
14	V SYNC
15	n/c

Table 13. SVGA Connector Pin-out.

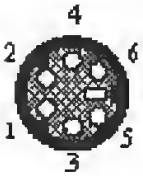
Serial & Parallel Ports

The COM1 serial port is a DB-9 DTE connector (J2) defined in the following table:

Pin	Signal	Pin	Signal
1	DCD	6	DSR
2	RxD	7	RTS
3	TxD	8	CTS
4	DTR	9	Ring indicator
5	Ground		

Table 14. DB-9 Pin-out

Keyboard



The keyboard connector is a 6-pin mini-DIN defined in the following table:

Pin	Signal	Pin	Signal
1	Keyboard Data	4	Keyboard VCC
2	not connected	5	Keyboard Clock
3	Ground	6	not connected

Table 15. Keyboard Connector Pin-out.

NOTES

55. Troubleshooting & Error Messages

Troubleshooting

This section deals with only the most common problems that you may encounter that do not provide an error message. If an error message is displayed, see the next section of this chapter, *Common Error Messages*.

Symptoms **Possible cause(s)** **Solution**

System appears to boot but provides no video. Monitor or cable problem. Video adapter failure. EPC-31/32 cannot talk to AT bus interface. Verify that the cable pins are not bent and the cable is fully seated in the video adapter. If necessary, try the monitor on another system to verify that the monitor is good. Replace video adapter. Verify that the EPC-31/32 is fully seated in the edge connector.

System fails at power-up -will not run power-on self-test. The system is not getting power. Hardware failure. Verify that +5V power is good and that the EPC is fully seated. Contact RadiSys Technical Support.

Symptoms **Possible cause(s)** **Solution**

Serial port(s) do not work. Port is disabled in the Setup screen. Interrupt conflicts. Port hardware failure. Press CTRL+ALT+ESC to enter the Setup screen. Use cursor arrows to move to the appropriate field and toggle the entry to enable the port. Another module may be using the same interrupts as COM1 and/or COM2. Verify that no other card in system is using IRQ3 or IRQ4. Contact RadiSys Technical Support.

Common Error Messages

This section contains a summary of the most common error and warning messages alphabetized by message text. These are messages generated by the BIOS and MS-DOS that may be related to your hardware configuration.

Bad or missing commend interpreter **DOS**

Problem The DOS operating system cannot find the Command line interpreter.

Solution(s) Either COMMAND.COM is not present at the specified (or default) directory level of the boot disk or the "SHELL=" statement in your CONFIG.SYS lists the file incorrectly (wrong directory or misspelled).

CMOS checksum invelid **BIOS**

Problem Something in the CMOS RAM is incorrect.

Solution(s) Run the BIOS setup program to determine what is wrong, and correct it. If the error occurs repeatedly, the EPC-31/32's battery has failed.

CMOS RAM error, check battery / run setup **BIOS**

Problem Something in the CMOS RAM is incorrect.

Solution(s) Run the BIOS setup program to determine what is wrong, and correct it. If the error occurs repeatedly, the EPC's battery has failed.

Diek boot failure, Insert system disk and press enter **BIOS**

Problem No boot disk could be found. Your hard disk may not have been partitioned into logical drive(s). EPC-31/32s look for logical drives to boot from. Hard disks are physical drives; partitions are logical drives.

Solution(s) If your BIOS setup screen has all disks disabled, or if your hard disk is disabled and no floppy diskette is inserted in the A: drive, run the BIOS setup program and verify that all disk parameters are correct. If they are, insert a bootable floppy disk in the A: drive and press enter. If a hard disk is present, verify that it is properly partitioned and formatted as a system disk and one partition is set active.

Diskette drives or types mismatch error - run setup **BIOS**

Problem The floppy diskette(s) installed in the system do not match the configuration information listed in the BIOS setup screen. This may be due to incorrect entries in the BIOS setup screen or one or both drives may not be responding at power-up.

Solution(s) Press CTRL+ALT+ESC to run the BIOS setup program. Make sure the BIOS setup entries relating to floppy drives correctly reflect the attached floppy drives. If you have no floppy drives, both drive A and drive B should be set to none.

Also, verify that all floppy drives are firmly connected (via ribbon cable) and that each

drive has power. If the floppy drive is getting power through the ribbon cable, make sure that the appropriate jumpers are set correctly.

error initializing hard disk 0 BIOS

Problem The on-board IDE disk controller cannot be initialized.

Solution(s) Ensure that the +5V power to the controller and hard disk are good and the ribbon cable to the hard disk is fully seated.

If you are not using an IDE drive, press CTRL+ALT+ESC to enter the BIOS setup program. Press F2 to enter the Fixed disk menu. Change the drive type to match the device being used.

Floppy disk cntrlr error or no cntrlr present BIOS

Problem The configuration information in the BIOS setup says that one or more floppy disk drives are expected, but a floppy disk controller could not be found.

Solution(s) If you have no floppy diskette drives, press CTRL+ALT+ESC to enter the setup program and set both floppy drives to "NONE."

If you are using a floppy drive(s), verify that both the floppy controller and the floppy drive(s) have power.

General Failure reading drive ... DOS

Problem This almost always indicates the presence of an unformatted hard disk partition or diskette.

Solution(s) Format the partition or diskette using the utilities supplies by your operating system.

Invalid drivs specification DOS

Problem You are trying to access a logical drive (e.g., A:, B:, ...) that is not known to the operating system.

Solution(s) Select a different logical drive. If you are trying to access a hard disk, you may need to create the logical partition.

Keyboard Error or no keyboard present BIOS

Problem This message indicates that the system did not recognize a keyboard at power-up or you pressed a key during the power-on self test.

Solution(s) Check the integrity of the keyboard connector.

If you think you pressed a key during power-up, reboot the system using the front panel reset button.

Some keyboards are designed with a switch (or jumper) to allow the user to configure the keyboard for use with an AT machine or an XT machine. If this is the case with your keyboard, verify that the switch is in the AT position.

The keyboard may not be a valid PC/AT keyboard (e.g., it is a PC/XT-only or PS/2 keyboard). If this is the case, replace the keyboard with a PC/AT style keyboard.

Memory parity interrupt at ... BIOS

Problem This could be a software error (reading a nonexistent memory area) or a true hardware failure.

Solution(s) Attempt to repeat the error. If the error occurs during the execution of your own proprietary software, verify that the memory location specified in your software is valid.

missing opsrating system BIOS

Problem Although the system could read the hard disk and find the active partition, the operating system files could not be found.

Solution(s) This can be caused by using a drive type number in the BIOS setup Fixed Disk menu that does not match the type number used to format the hard disk. Press CTRL+ALT+ESC to run the BIOS setup program. Press F2 to enter the Fixed Disk menu. Select the correct drive type to match the type used to format the disk originally. Save the changes and reboot the system.

This can also occur if the hard disk is partitioned and one partition is set active, but the partition is not formatted. Format the partition using the utilities supplied with your

operating system.

Non-system disk or disk error BIOS
replace and press any key when reedy

Problem This is caused by an attempt to boot from a disk or diskette that is not recognized as a system disk; that is no system files exist on the disk or diskette.

Solution(s) Most often it results when you reboot with a non-system diskette in the floppy drive, because the BIOS always attempts to boot from the floppy drive if a diskette is installed. If you are trying to boot from the hard disk, make sure that you do not have a diskette in drive A and press any key.
If you are trying to boot from floppy, insert a known good bootable system diskette in drive A and press any key.

Not ready reading drive ... DOS

Problem This is usually caused by not fully inserting a diskette into the floppy drive.

Solution(s) Eject the floppy diskette and reinsert making sure that the diskette seats completely into the floppy drive.

Perity error in segment ... DOS

Problem This could be a software error (reading a nonexistent memory area) or a true hardware failure.

Solution(s) Attempt to repeat the error. If the error occurs during the execution of your own proprietary software, verify that the memory location specified in your software is valid.

press a key to reboot BIOS

Problem A C: drive exists but is not set active.

Solution(s) Run your operating system disk partitioning program (like FDISK) and set the primary partition active.

Real time clock error - run setup BIOS

Problem The battery-backed TOD clock is incorrect.

Solution(s) Run the BIOS setup program to determine what is wrong, and correct it. If the error occurs repeatedly, the EPC-31/32's battery has failed.

NOTES

6. Upgrades

* do not handle the epc-31/32 module unless you are in a static-free environment.

Memory

The EPC-31/32 SIMM module can accommodate a single 4 MB, 8 MB, or 16 MB SIMM with the following specifications:

	72 pin
	fast page mode
	80 nanosec. (or better)
	single-sided or double-sided
For 4 MB,	Use a 1M x 36 SIMM.
	RadiSys P/N 70-0070
	We recommend Toshiba THM361020ASG-80 or equivalent
For 8 MB,	Use a 2M x 36 SIMM.
	RadiSys P/N 70-0041
	We recommend Toshiba THM362020ASG-80 or equivalent
For 16 MB,	Use a 4M x 36 SIMM.
	RadiSys P/N 70-0053
	We recommend Toshiba THM364020SG-70 or equivalent

After upgrading the memory, reboot the system. The error message "`Memory Size error - run setup`" will display after the power-on self-test completes. Press CTRL+ALT+ESC to enter the Main Setup Menu. Verify that the top line of this screen shows the correct amount of memory. Press F10 to save and F5 to confirm and reboot. The system will reboot and no error messages should be displayed.

NOTES

7. Support and Service

In North America

Technical Support

RadiSys maintains a technical support phone line at (503) 646-1800 that is staffed weekdays (except holidays) between 8 AM and 5 PM Pacific time. If you have a problem outside these hours, you can leave a message on voice-mail using the same phone number. You can also request help via electronic mail or by FAX addressed to RadiSys Technical Support. The RadiSys FAX number is (503) 646-1850. The RadiSys E-mail address on the Internet is *support@radisys.com*. If you are sending
E-mail or a FAX, please include information on both the hardware and software being used and a detailed description of the problem, specifically how the problem can be reproduced. We will respond by E-mail, phone or FAX by the next business day.
Technical Support Services are designed for customers who have purchased their products from RadiSys or a sales representative. If your RadiSys product is part of a piece of OEM equipment, or was integrated by someone else as part of a system, support will be better provided by the OEM or system vendor that did the integration and understands the final product and environment.

Bulletin Board

RadiSys operates an electronic bulletin board (BBS) 24 hours per day to provide access to the latest drivers, software updates and other information. The bulletin board is not monitored regularly, so if you need a fast response please use the telephone or FAX numbers listed above.
The BBS operates at up to 14400 baud. Connect using standard settings of eight data bits, no parity, and one stop bit (8, N, 1). The telephone number is (503) 646-8290.

Repair Services

Factory Repair Service is provided for all RadiSys products. Standard service for all RadiSys products covers factory repair with customers paying shipping to the factory and RadiSys paying for return shipment. Overnight return shipment is available at customer expense. Normal turn-around time for repair and re-certification is five working days.
Quick Exchange services (immediate shipment of a loaner unit while the failed product is being repaired) or other extra-cost services can be arranged, but need to be negotiated in advance to allow RadiSys to pool the correct product configurations. RadiSys does not maintain a general "loaner" pool: units are available only for customers that have negotiated this service in advance.
RadiSys does not provide a fixed-price "swap-out" repair service, as customers have indicated that issues of serial number tracking and version control make it more convenient to receive their original products back after repair.

Warranty Repairs

Products under warranty (see warranty information in the front of this manual) will have manufacturing defects repaired at no charge. Products sent in for warranty repair that have no faults will be subject to a recertification charge. Extended Warranties are available and can be purchased at a standard price for any product still under warranty. RadiSys will gladly quote prices for Extended Warranties on products whose warranties have lapsed; contact the factory if this applies.
Customer induced damage (resulting from misuse, abuse, or exceeding the product specifications) is not covered by the standard product warranty.

Non-Warranty Services

There are several classes of non-warranty service. These include repair of customer induced problems, repairs of failures for products outside the warranty period, recertification (functional testing) of a product either in or out of warranty, and procurement of spare parts.
All non-warranty repairs are subject to service charges. RadiSys has determined that pricing repairs based on time and materials is more cost-effective for the customer than a flat-rate repair charge. When product is received, it will be analyzed and, if appropriate, a cost estimate will be communicated to the customer for authorization. After the customer authorizes the repair and billing arrangements have been made, the product will be repaired and returned to the customer.
A recertification service is provided for products either in or out of warranty. This service will verify correct operation of a product by inspection and testing of the product with standard manufacturing tests. There is a product-dependent charge for recertification.

There are only a few components that are generally considered field-repairable, but, because RadiSys understands that some customers want or need the option of repairing their own equipment, all components are available in a spares program. There is a minimum billing charge associated with this program.

Arranging Service

To schedule service for a product, please call RadiSys Technical Support directly at (503) 646-1800. Have the product model and serial numbers available, along with a description of the problem. A Technical Support representative will issue a Returned Materials Authorization (RMA) number, a code number by which we track the product while it is being processed. Once you have received the RMA number, follow the instructions of the Technical Support representative and return the product to us, freight prepaid, with the RMA number clearly marked on the exterior of the package. If possible re-use the original shipping containers and packaging. In any case, be sure you follow good ESD-control practices when handling the product, and ensure that anti-static bags and packing materials with adequate padding and shock-absorbing properties are used.

Ship the product, freight prepaid, to

Product Service Center
RadiSys Corporation
15025 SW Koll Parkway
Beaverton, Oregon 97006-6902

When shipping the product, include the following information: return address, contact names and phone numbers in purchasing and engineering, and a description of the suspected problem. Any ancillary information that might be helpful with the debugging process will be appreciated.

Other Countries

Contact the sales organization from which you purchased your RadiSys product for service and support.

Appendix A:
Mechanical Dimensions

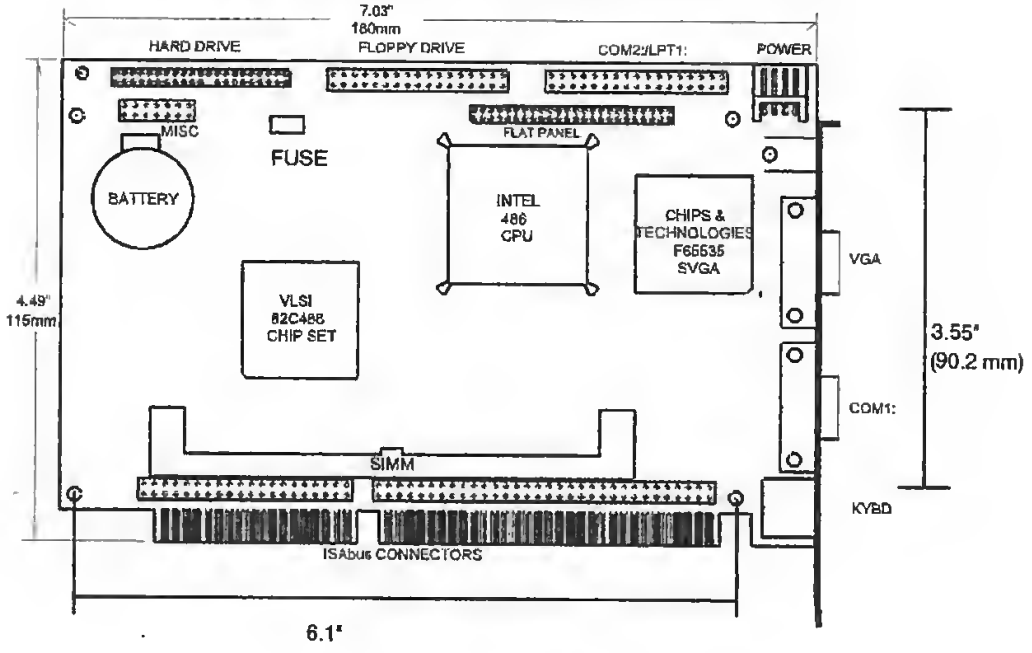


Figure 5. EPC-31/32 Mechanical Dimensions.

Mounting holes on the EPC-31/32 are 1/8" (0.125") or 3.175 mm. The spacing of the mounting holes is 6.1" (154.9 mm) by 3.55" (90.2 mm). Refer to Figure 6.

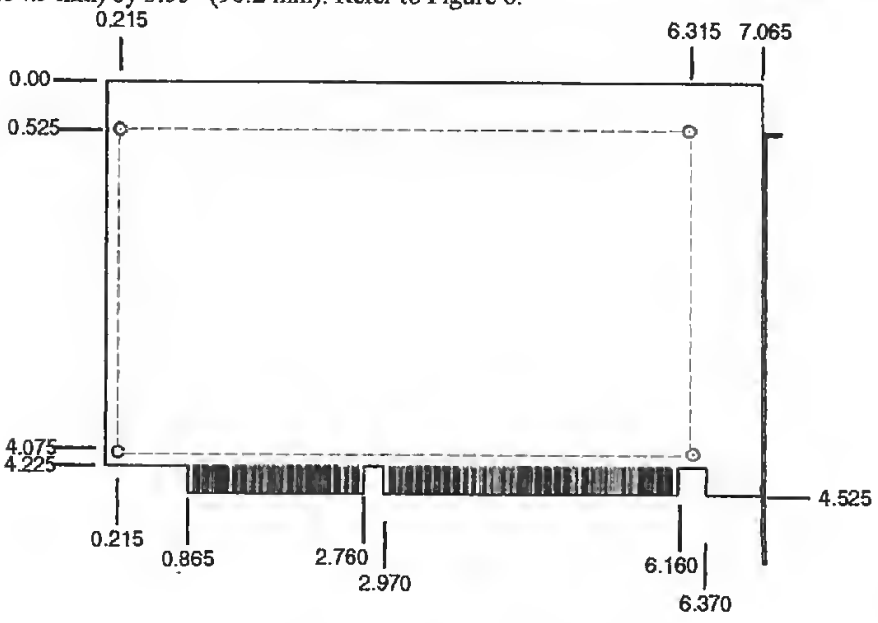


Figure 6. Mounting Hole Dimensions.

Appendix B:
Chip Set and I/O Map

Memory Map

The Intel486 SX or DX supports 25 bits of the 32-bit physical memory address. Memory at addresses between 0 and the theoretical maximum of 20 MB (13FFFFFh) is mapped as follows:

Range	Content
0000000 - 009FFFF	DRAM (first 640 KB)
00A0000 - 00BFFFF	on board video memory
00C0000- 00C7FFF	Write-protected DRAM containing video BIOS
00C8000 - 00CFFFF	Uncommitted
00D0000 - 00EFFFF	Uncommitted
00F0000 - 00FFFFF	Write-protected DRAM containing BIOS
0100000 - 13FFFFF	Extended memory
1400000 - 1FEFFFF	Extended memory
1FF0000 - 1FFFFFF	Mapped to BIOS ROM

Table 16. Memory Map.

C8000 - 0EFFFF may be used either as page frame, BIOS extension, I/O buffer (i.e. for extended memory managers, Ethernet, etc.) or may be used by DOS as upper memory blocks if an extended memory manager driver is installed.

I/O Address Maps

The following defines the I/O addresses decoded by the EPC-31/32.

First (8-bit) DMA controller: VL82C486 chip emulating 8237 of PC/AT

I/O Addr	Functional group Usage
000 DMA	Channel 0 address
001	Channel 0 count
002	Channel 1 address
003	Channel 1 count
004	Channel 2 address
005	Channel 2 count
006	Channel 3 address
007	Channel 3 count
008	Command/status
009	DMA request
00A	Command register (R)
	Single-bit DMA req mask (W)
00B	Mode
00C	Set byte pointer (R)
	Clear byte pointer (W)

00D	Temporary register (R) Master clear (W)
00E	Clear mode reg counter (R) Clear all DMA req mask (W)
00F	All DMA request mask

Table 17. First (8-bit) DMA Controller Map.

First Interrupt Controller: VL82C486 emulating 8259 of PC/AT

I/O Addr	Functional group	Usage
020	Interrupt Controller 1	Port 0
021		Port 1

Table 18. First Interrupt Controller Map.

Counter-Timer functions: VL82C486 emulating 8254 of PC/AT

I/O Addr	Functional group	Usage
040	Timer	Counter 0
041		Counter 1
042		Counter 2
043		Control (W)

Table 19. Counter-Timer Functions Map.

Keyboard Port: VL82C114 emulating 8742 of PC/AT

I/O Addr	Functional group	Usage
060	Keyboard controller	Data I/O register
061	NMI status	NMI status
064	Keyboard controller	Command/status register

Table 20. Keyboard Port Map.

Time-of-Day Clock: VL82C114 emulating MC6818 of PC/AT

I/O Addr	Functional group	Usage	
070	Real-time clock	RTC index reg / NMI enable	
071		RTC data register	
		0	seconds
		1	seconds alarm
		2	minutes
		3	minutes alarm
		4	hours
		5	hours alarm
		6	day of week
		7	date of month
		8	month
		9	year
		A	status A
		B	status B
		C	status C
		D	status D
		E	RAM
		...	
		3F	RAM

Table 21. Time-of-Day Clock Map.

DMA Page Registers: VL82C486 emulating 74LS612 of PC/AT

I/O Addr	Functional group	Usage
081	DMA	Channel 2 page register
082		Channel 3 page register
083		Channel 1 page register
087		Channel 0 page register
089		Channel 6 page register
08A		Channel 7 page register
08B		Channel 5 page register
08F		Refresh page register

Table 22. DMA Page Registers Map.

Miscellaneous:

I/O Addr	Functional group	Usage
092	82C486 Controller	Port A(R/W)

Table 23. Miscellaneous Features Map.

Second Interrupt Controller: VL82C486 emulating 8259 of PC/AT

I/O Addr	Functional group	Usage
0A0	Interrupt controller 2	Port 0
0A1		Port 1

Table 24. Second Interrupt Controller Map.

Second (16-bit) DMA Controller: VL82C486 emulating 8237 of PC/AT

I/O Addr	Functional group	Usage
0C0	DMA	Channel 4 address
0C2		Channel 4 count
0C4		Channel 5 address
0C6		Channel 5 count
0C8		Channel 6 address
0CA		Channel 6 count
0CC		Channel 7 address
0CE		Channel 7 count
0D0		Command/status
0D2		DMA request
0D4		Command register (R)
		Single-bit DMA req mask(W)
0D6		Mode
0D8		Set byte pointer (R)
		Clear byte pointer (W)
0DA		Temporary register (R)
		Master clear (W)
0DC		Clear mode reg counter (R)
		Clear all DMA req mask (W)
0DE		All DMA request mask

Table 25. Second (16-bit) DMA Controller Map.

VL82C486 controller:

I/O Addr	Functional group	Usage
0EC		Index register (R/W)

0ED	Data register (R/W)

Table 26. VL82C486 Controller Map.

Coprocessor Interface: (Not used with an EPC-31 80486SX)

I/O Addr	Functional group	Usage
0F0	Coprocessor	Clear coprocessor busy
0F1		Reset coprocessor

Table 27. Coprocessor Interface Map.

VL82C486 controller:

I/O Addr	Functional group	Usage
0F4	82C486 Controller	Slow CPU Register(W)
0F5		Fast CPU Register(W)
0F9		Configuration Disable(W)
0FB		Configuration Enable(W)

Table 28. VL82C486 Controller Map.

Serial I/O (COM2:) Port: SMC FDC37C651 emulates 8250 of PC/AT

I/O Addr	Functional group	Usage
2F8	COM2: serial port	Receiver/transmitter buffer
		Baud rate divisor latch (LSB)
2F9		Interrupt enable register
		Baud rate divisor latch (MSB)
2FA		Interrupt ID register
2FB		Line control register
2FC		Modem control register
2FD		Line status register
2FE		Modem status register

Table 29. COM2 Serial I/O Port Map.

Parallel I/O (LPT1:) Port: SMC FDC37C651

I/O Addr	Functional group	Usage
278	LPT1: parallel port	Data port
279		Status port
27A		Control port

Table 30. Parallel I/O (LPT1) Port Map.

Super VGA controller: C&T 65535

I/O Addr	Functional group	Usage
102	Global enable	Global enable register
3B0	MDA	reserved
3B1		reserved
3B2		reserved
3B3		reserved
3B4	MDA/CGA/EGA/VGA	CRTC index
3B5		CRTC data
3B6	MDA	reserved
3B7		reserved
3B8		Hercules mode register
3B9	Mono (all)	Set light pen (ignored)

3BA		Status register (R) Feature control register (W)
3BB		Clear light pen (ignored)
3BF	MDA	Hercules configuration register
3C0	MDA/CGA/VGA	Attribute controller index/data
3C1		Attribute controller index/data
3C2	EGA/VGA	Misc. output register (W) Feature read register (R)
3C3		Video subsystem enable
3C4		Sequencer index
3C5		Sequencer data
3C6	Palette	Color palette mask
3C7		Color palette state (R) Color palette read mode ind.(W)
3C8		Color palette write mode index
3C9		Color palette data
3CA	VGA	Feature read register (R)
3CB	unused	unused
3CC	VGA	Misc. output register(R)
3CD	unused	unused
3CE	EGA/VGA	Graphics controller index
3CF		Graphics controller data
3D0	unused	unused
3D1		unused
3D2		unused
3D3		unused
3D4		CRTC index
3D5		CRTC data
3D6	Flat panel control	CHIPS extension index
3D7		CHIPS extension data
3D8	CGA	CGA mode register
3D9		CGA color register
3DA	Color (all)	Feature control register (W) Status register (R)
3DB		Clear light pen (ignored)
3DC		Set light pen (ignored)

Table 31. Super VGA Controller Map.

Serial I/O (COM1:) Port: SMC FDC37C651 emulates 8250 of PC/AT

I/O Addr	Functional group	Usage
3F8	COM1: serial port	Receiver/transmitter buffer
		Baud rate divisor latch (LSB)
3F9		Interrupt enable register
		Baud rate divisor latch (MSB)
3FA		Interrupt ID register
3FB		Line control register
3FC		Modem control register
3FD		Line status register
3FE		Modem status register

Table 32. COM1 Port Map.

Floppy disk drive controller: SMC FDC37C651

I/O Addr	Functional group	Usage
3F2	Floppy disk controller	Digital output register
3F4		Main status register
3F5		Data, status 0-3 registers
3F7		Data rate / digital in registers

Table 33. Floppy Disk Drive Controller Map.

IDE hard disk drive: External; decoded by SMC FDC37C651

I/O Addr	Functional group	Usage
1F0	IDE hard disk drive	Task file registers
1F1		(~HCS0 to drive active)
1F2		
1F3		
1F4		
1F5		
1F6		
1F7		
3F6		Misc. AT registers
3F7		(~HCS1 to drive active)

Table 34. IDE Hard Disk Drive Controller Map.

Flash disk subsystem:

380	Flash disk	Flash address low (W)
381		Flash address middle (W)
382		Flash address high (W)
383		Flash data

Table 35. Flash Disk Subsystem Map.

Watchdog timer:

384	Watchdog timer	Timeout select / enable reg. (W) Reset timer (R)

Table 36. Watchdog Timer Map.

Appendix C:
AT Bus Connector Signals

AT Bus Expansion Connector Signals

The signal definitions below are listed in alphabetical order. Signal definitions preceeded by a are copied from the *IBM AT Technical Reference Manual*

-0WS (I)

The 'zero wait state' signal tells the microprocessor that it can complete the present bus cycle without inserting any additional wait cycles. In order to run a memory cycle to a 16-bit device without wait cycles, 0WS is derived from an address decode gated with a Read or Write command. In order to run a memory cycle to an 8-bit device with a minimum of two wait states, 0WS should be driven active one clock cycle after the Read or Write command is active, and gated with the address decode for the device. Memory Read and Write commands to an 8-bit device are active on the falling edge of CLK. 0WS is active low and should be driven with an open collector or tri-state driver capable of sinking 20 mA.

AEN (O)

The 'address enable' signal is used to degate the microprocessor and other devices from the I/O channel to allow DMA transfers to take place. When this line is active, the DMA controller has control of the address bus, the data-bus Read command lines (memory and I/O), and the Write command lines (memory and I/O). This signal is active high.

BALE (O) (buffered)

The 'buffered address latch enable' signal is provided by the Bus Controller and is used to latch valid addresses and memory decodes from the microprocessor. It is available to the I/O channel as an indicator of a valid microprocessor or DMA address (when used with 'address enable' signal, AEN). Microprocessor addresses SA0 through SA16 are latched with the falling edge of BALE. BALE is forced high (active) during DMA cycles.

CLK (O)

This is the 8-MHz system 'clock' signal. It is a synchronous microprocessor cycle clock with a cycle time of 125 nanoseconds. The clock has a 50% duty cycle. This signal should be used only for synchronization. It is not intended for uses requiring a fixed frequency.

~DACK0 through ~DACK3, ~DACK5, ~DACK6 & ~DACK7 (O)

~DMA acknowledge signals are used to acknowledge DMA requests. These signals are active low.

DRQ0 through DRQ3, DRQ5, DRQ6, DRQ7 (I)

The 'DMA request' signals are asynchronous channel requests used by peripheral devices and a microprocessor to gain DMA service (or control of the system). They are prioritized, with DRQ0 having the highest priority and DRQ6 the lowest. A request is generated by bringing a DRQ line to an active (high) level. A DRQ line is held high until the corresponding 'DMA acknowledge' (DACK) line goes active. DRQ0 through DRQ3 perform 8-bit DMA transfers, DRQ5 and DRQ6 perform 16-bit transfers. DRQ4 is used on the system board and is not available on the I/O channel.

~I/OCHK (I)

The 'I/O channel check' signal provides the system board with parity (error) information about memory or devices on the I/O channel. When this signal is active (low), it indicates a non-correctable system error.

-I/OCHRDY (I)

The 'I/O channel ready' signal is pulled low (not ready) by a memory or I/O device to lengthen I/O or memory cycles. Any slow device using this line should drive it low immediately upon detecting its valid address and a Read or Write command. Machine cycles are extended by an integral number of clock cycles (125 nanoseconds). This signal should be held low for no more than 2.5 microseconds.

~I/OCS16 (I)

The 'I/O 16-bit chip select' signal indicates to the system that the present data transfer is a 16-bit I/O cycle. It is derived from an address decode.

~I/OCS16 is active low and should be driven with an open collector or tri-state driver capable of sinking

20 mA.

~IOR (I/O)

The '~I/O read' signal instructs an I/O device to drive its data onto the data bus. This signal may be driven by the system microprocessor or DMA controller, or by a microprocessor or DMA controller resident on the I/O channel. This signal is active low.

~IOW (I/O)

The '-I/O write' signal instucts an I/O device to read the data off the data bus. It may be driven by any microprocessor or DMA controller in the system. This signal is active low.

IRQ3 through IRQ7, IRQ9, IRQ10, IRQ11, IRQ12, IRQ14, & IRQ15 (I)

Interrupt requests 3 through 7, 9, 11, 12, 14, and 15 are used to signal the microprocessor that an I/O device needs attention. The interrupt requests are prioritized, with IRQ9, IRQ11, IRQ12, IRQ14 and IRQ15 having the highest priority (IRQ9 is the highest), and IRQ3 through IRQ7 having the lowest priority (IRQ7 is the lowest). An interrupt request is generated when an IRQ line is raised from low to high. The line is high until the microprocessor acknowledges the interrupt request (Interrupt service routine).

LA17 through LA23 (I/O)

These signals (unlatched) are used to address memory and I/O devices within the system. They give the system up to 16M of addressability. These signals are valid when BALE is high. LA17 through LA23 are not latched during microprocessor cycles and therefore do uot stay valid for the whole cycle. Their purpose is to generate memory decodes for 16-bit, 1 wait-state, memory cycles. These decodes should be latched by I/O adapters on the falling edge of BALE.

~MASTER (I)

This signal is used with a DRQ line to gain control of the system. A processor or DMA controller on the I/O channel may issue a DRQ to a DMA channel in cascade mode and receive a ~DACK. Upon receiving the ~DACK, a microprocessor may pull ~MASTER active (low), which will allow it to control the system address, data, and control lines (a condition known as tri-state). After ~MASTER is low, the microprocessor must wait one clock cycle before driving the address and data lines, and two clock cycles before issuing a Read or Write command. If this signal is held low for more than 15 microseconds, the system memory may be lost because of a lack of refresh.

~MEMCS16 (I)

The '-memory 16-bit chip select' signal indicates to the system that the present data transfer is a 16-bit memory cycle. It must be derived from the decode of LA17 through LA23. ~MEMCS16 is active low and should be driven with an open collector or tri-state driver capable of sinking 20 mA.

OSC (O)

The 'oscillator' signal is a high-speed clock with a 70-nanosecond period (14.31818 MHz). This signal is not synchronous with the system clock. It has a 50% duty cycle.

~REFRESH (I/O)

This signal is used to indicate a refresh cycle and can be driven by a microprocessor on the I/O channel. This signal is active low.

RSTDRV (O)

The 'reset drive' signal is used to reset or initialize system logic at power-up time or during a low voltage condition. This signal is active high.

SA0 through SA19 (I/O)

Address signals 0 through 16 are used to address memory and I/O devices within the system. These address lines, in addition to LA17 through LA23 (unlatched version of the SA signal), allow access of up to 16M of memory. SA0 through SA17 are gated on the system bus when 'buffered address latch enable' signal (BALE) is high and are latched on the falling edge of BALE. These signals are generated by the microprocessor or DMA controller. They also may be driven by other microprocessors or DMA controllers that reside on the I/O channel.

~SBHE (I/O)

The '-system bus high enable' signal indicates a transfer of data on the upper byte of the data bus, SD8 through SD15. 16-bit deives use ~SBHE to condition data bus buffers tied to SD8 through SD15. This signal is active low.

SD0 through SD15 (I/O)

These signals provide bus bits 0 through 15 for the microprocessor, memory, and I/O devices. D0 is the least-significant bit and D15 is the most-significant bit. All 8-bit devices on the I/O channel should use D0 through D7 for communications to the microprocessor. The 16-bit devices will use D0 through D15. To support 8-bit devices, the data on D8 through D15 will be gated to D0 through D7 during 8-bit transfers to these devices; 16-bit microprocessor transfers to 8-bit devices will be converted to two 8-bit transfers.

-SMEMR (O) -MEMR (I/O)

These signals instruct the memory devices to drive data onto the data bus.

~SMEMR is active only when the memory decode is within the low 1M of memory space. ~MEMR is active on all memory read cycles. ~MEMR may be driven by any microprocessor or DMA controller in the system. ~SMEMR is derived from

~MEMR and the decode of the low 1M of memory. When a microprocessor on the I/O channel wishes to drive ~MEMR, it must have the address lines valid on the bus for one clock cycle before driving ~MEMR active. Both signals are active low.

~SMEMW (O) ~MEMW (I/O)

These signals instruct the memory devices to store the data present on the data bus. ~SMEMW is active only when the memory decode is within the low 1M of the memory space. ~MEMW is active on all memory write cycles. ~MEMW may be driven by any microprocessor or DMA controller in the system. ~SMEMW is derived from ~MEMW and the decode of the low 1M of memory. When a microprocessor on the I/O channel wishes to drive ~MEMW, it must have the address lines valid on the bus for one clock cycle before driving ~MEMW active. Both signals are active low.

TC (O)

The 'terminal count' signal provides a high pulse when the terminal count for any DMA channel is reached.

Appendix D:
Video Modes and Supported Panels

The EPC-31/32 will support color 640 x 400 and color 640 x 480 panels from: Epson (LCD), Fujitsu (plasma), Hitachi (LCD, Color LCD*), Kyocera (LCD*), Optrex (LCD), Panasonic (Plasma), Planar (EL), Sanyo (LCD), Sharp (LCD, Color TFT, EL* some), Toshiba (LCD).
The EPC-31/32 will support monochrome panels from: Epson (LCD), Fujitsu (plasma), Hitachi (LCD), Kyocera (LCD*), Optrex (LCD), Panasonic (Plasma), Planar (EL), Sanyo (LCD), Sharp (LCD, EL*some), Toshiba (LCD).

** External circuitry required*

Interface tables for the EPC-31/32 and tbe following panels are included here:

Sharp Monochrome LCD (BIOS setting for Monochrome - default)
640 x 480 LM64P80

Sharp Passive Color LCD (BIOS setting for Passive Color)
640 x 480 LM64C08P

Sharp 512 Color TFT (BIOS setting for Active Color)
640 x 480 LQ10DH11

Optrex Monochrome LCD (BIOS setting for Electroluminescence)
640 x 200 DMF651AN

Optrex Monochrome LCD (Contact RadiSys for more information about this panel)
640 x 200 DMF651AN

Seiko Monochrome LCD (Contact RadiSys for more information about this panel)
320 x 240 G321EX5R000

Sharp Monochrome LCD (Monochrome BIOS - default)
640 x 480 LM64P80

LM64P80	Signal Name	EPC-31/32	Signal Name
1	S	15	FLM
2	CP1	19	LP
3	CP2	25	SCLK
4	DISP	11	GND
5	VDD	1	VCC
6	VSS	17	GND
7	VEE	7	ENAVDD
8	DU0	37	P3
9	DU1	35	P2
10	DU2	31	P1
11	DU3	21	-SCLK
12	DL0	49	P7
13	DL1	47	P6
14	DL2	43	P5
15	DL3	41	P4

Sharp Passive Color LCD (Use Passive Color BIOS)
640 x 480 LM64C08P

LM64C08P CN1	Signal Name	EPC-31/32	Signal Name
1	YD	15	FLM
2	LP	19	LP

3	XCK	25	SCLK
4	DISP	1	VCC
5	VDD	1	VCC
6	VSS	11	GND
7	VEE	5	n/c
8	DU0	12	P11
9	DU1	10	P10
10	DU2	6	P9
11	DU3	4	P8
12	DU4	37	P3
13	DU5	35	P2
14	DU6	31	P1
15	DU7	29	P0
CN2			
16	VSS	17	GND
17	DL0	24	P15
18	DL1	22	P14
19	DL2	18	P13
20	DL3	16	P12
21	DL4	49	P7
22	DL5	47	P6
23	DL6	43	P5
24	DL7	41	P4
25	VSS	23	GND

Sharp 512 Color TFT (Use Active Color BIOS)
640 x 480 LQ10DH11

LQ10DH11		Signal Name		EPC-31/32	Signal Name
1	GND	11	GND		
2	CK	25	SCLK		
3	R1	18	P13		
4	R0	16	P12		
5	GND	11	GND		
6	R2	22	P14		
7	G1	4	P8		
8	G0	49	P7		
9	GND	33	GND		
10	G2	6	P9		
11	B1	37	P3		
12	B0	35	P2		
13	GND	23	GND		
14	B2	41	P4		
15	GND	27	GND		
16	HSYNC	19	LP		
17	VCC	1	VCC		
18	VSYNC	15	FLM		
19	VDD	3	n/c		
20	GND	33	GND		
21	NC				
22	NC				

Sharp Grey Scale EL (Use Electroluminescence BIOS)
640 x 400 LJ640U34

LJ640U34	Signal Name		EPC-31/32	Signal Name
A1	D0	29	P0	
B2	D1	31	P1	
A2	CKD	21	~SCLK	
B2	GND	11	GND	
A3	HORIZ. SYNC		19	LP
B3	GND	17	GND	
A4	VERT SYNC		15	FLM
B4	NC			
A5	GND	23	GND	
B5	GND	27	GND	
A6	NC			
A6	NC			
A7	VL (+5V)	1	VCC	
B7	VL (+5V)	1	VCC	
A8	VD (+12V)		3	n/c
B8	VD (+12V)		3	n/c

Optrex Monochrome LCD (Contact RadiSys for more information)
640 x 200 DMF651AN

DMF651AN		Signal Name		EPC-31/32	Signal Name
1	FLM	15	FLM		
2	LP	19	LP		
3	CP	25	SCLK		
4	M	13	M		
5	VADJ	7	ENAVDD		
6	VCC	1	VCC		
7	VSS	11	VSS		
8	VEE	7	ENAVDD		
9	D0	29	P0		
10	D1	31	P1		
11	D2	35	P2		
12	D3	37	P3		

Seiko Monochrome LCD (Contact RadiSys for more information)
320 x 240 G321EX5R000

G321EX5R000		Signal Name		EPC-31/32	Signal Name
1	FLM	15	FLM		
2	M	13	M		
3	CL1	19	LP		
4	CL2	25	SCLK		
5	D OFF	11	GND		
6	D0	29	P0		
7	D1	31	P1		
8	D2	35	P2		
9	D3	37	P3		
10	VDD	1	VCC		
11	VSS	17	GND		
12	VLC	7	ENAVDD		
13	VO	*			
14	FG	27	GND